

DISTRIBUTIONAL SURVEY OF THE MEADOW JUMPING MOUSE (*ZAPUS*  
*HUDSONIUS*) IN THE NORTHERN GREAT PLAINS:  
TRAPPING REPORT, SUMMER 2005

A progress report compiled for  
U.S. Fish and Wildlife Service  
Region 6  
Denver, Colorado

by

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## INTRODUCTION

In spring of 2004, Ramey et al. (2004) released the results of a taxonomic study on the meadow jumping mouse (*Zapus hudsonius*), and therein questioned the taxonomic status of Preble's meadow jumping mouse (subspecies *Z. h. preblei*). Their work suggested that the putative subspecies *Z. h. preblei*, known to occur only in Colorado and southern Wyoming, was actually *Z. h. campestris*, a subspecies that occurs in the Black Hills region of northeastern Wyoming, western South Dakota, and southeastern Montana. Soon after the results of this study were released, the U.S. Fish and Wildlife Service (USFWS) received petitions to remove *Z. h. preblei* from the Federal List of Threatened and Endangered Wildlife and Plants (USFWS 2004a). In response to the delisting petitions, USFWS determined that the work by Ramey et al. (2004) represented the best available information on the taxonomy of the subspecies. In January 2005, the USFWS began taking the necessary steps to remove *Z. h. preblei* from the Federal List of Threatened and Endangered Wildlife and Plants (USFWS 2005).

A subsequent study published by Ramey et al. (2005) concluded that both *Z. h. preblei* and another wide-ranging eastern subspecies (*Z. h. intermedius*) did not significantly differ from *Z. h. campestris*. A final decision regarding the status of Preble's meadow jumping mouse was anticipated for early 2006, before which time the USFWS sought additional information on the taxonomic classification and population status of the putative subspecies *Z. h. preblei* and *Z. h. campestris* (USFWS 2005).

Research efforts during recent years helped increase our understanding of the distribution, taxonomy, and population dynamics of *Z. h. preblei* in Colorado and southeastern Wyoming, but such information for subspecies occurring in other areas of the Northern Great Plains was not forthcoming (Cryan 2004). In particular, little was known concerning the status of *Z. h. campestris* in and around the Black Hills region (Cryan 2004). Systematic surveys or monitoring efforts directed toward *Z. h. campestris* had not been carried out (Cryan 2004) and claims of population decline due to loss of riparian habitats in the Black Hills (Center for Native Ecosystems et al. 2004) were unsubstantiated. A clearer understanding of the taxonomy and occurrence of *Z. hudsonius* in the Northern Great Plains was needed. In response to this need, the United States Geological Survey (USGS) partnered with USFWS to conduct an additional genetic analysis of *Z. hudsonius* and to investigate occurrence of the species in the Northern Great Plains.

Our primary objective during the summer of 2005 was to collect tissue samples from meadow jumping mice at geographically important locations in the Northern Great Plains. These samples were collected for a genetic study led by Tim King of the USGS Leetown Science Center (under a separate study plan). In addition to this primary objective, we sought to simultaneously survey and document the occurrence of *Z. h. campestris* at historical localities in the Black Hills and Bear Lodge Mountains of southwestern South Dakota and northeastern Wyoming.

## STUDY AREA AND METHODS

Trapping areas – Trapping and genetic sampling was conducted on federal and state lands in northeastern Wyoming, southeastern Montana, South Dakota, and Nebraska.

Descriptions of all capture localities and maps of each are included in Appendices A and B, respectively. Representative photos of capture localities are included in Appendix C.

Herein we use the term “locality” to describe specific places where trapping occurred and the term “site” to describe a group of sampling localities in close proximity to each other.

The six primary and one alternate (see below) sites where we attempted to collect tissue samples for the genetic study are depicted in Figure 1. These sites were: Site 1) the Bear Lodge Mountains, WY; Site 2) the Black Hills, SD; Site 3) Carter County, MT; Site 4) Lacreek National Wildlife Refuge, SD; Site 5) Sand Lake National Wildlife Refuge, SD; and Site 6) Kearney, NE. We selected the original six sites because relatively high numbers of jumping mice ( $> 20$ ) were historically captured at each site, and because they represent geographically separate pairs of samples from each of the three putative subspecies of meadow jumping mouse in the region (*Z. h. campestris*, *Z. h. intermedius*, and *Z. h. pallidus*). Subspecies boundaries for site selection were based on distribution maps in Krutzch (1954). Sample sites 1 and 2 represent *Z. h. campestris*, sites 3 and 5 represent *Z. h. intermedius*, and sites 4 and 6 represent *Z. h. pallidus*. At all genetic sampling sites, tissue samples from *Z. hudsonius* were collected within  $\leq 12$  km of each other, but typically within  $\leq 5$  km. Because we were unable to capture jumping mice at one of the primary sampling sites (3a; Fig. 1), capture attempts were made at 3 alternate sites (3b, 3c, 3d; Fig. 1). During our travels to conduct genetic sampling at sites farthest from Fort Collins, we made additional stops at other localities in the Black Hills where *Z.*

*h. campestris* had been captured in the past. All of the historical localities that we trapped in the Black Hills are shown in Figure 2.

Capture methods – Trapping occurred between 23 May and 19 August 2005 and focused on habitats surrounding perennial streams, irrigation ditches, marshes, ponds, lakes, and rivers. Based on known patterns of occurrence in western regions (e.g., Whitaker 1972, Jones et al. 1983), upland habitats were not sampled.

All animals were captured using live traps, and we followed protocols approved by the Fort Collins Science Center Institutional Animal Care and Use Committee. At the six sites from which tissue samples were required, target habitats were trapped until the requisite number ( $n = 30$ ) of individuals was captured. At other historical localities, traps were set in the area for up to three days or until *Z. hudsonius* was captured.

Trap lines consisted of both single and parallel rows of Sherman live traps (H. B. Sherman Traps, Inc., Tallahassee, FL), with 5 to 10 meters between traps. Typically, trap lines were within 1 to 2 m of water sources, but occasionally were about 10 m from water. Trap lines consisted of between 40 and 120 traps set flush with the ground and concealed within vegetation. Total numbers of traps deployed at each locality ranged from 160 to 420 traps, depending on the number of personnel available. Traps were baited with rolled oats or livestock feed (Manna Pro Sweet) approved by USFWS for trapping *Z. hudsonius*. Terminal points of trap lines were flagged and their coordinates were recorded using a global positioning system (GPS, NAD 27 datum). Traps were set

and opened in the early evening and checked the next morning within two hours of sunrise. All traps were retrieved each morning and those containing animals of any species were cleaned prior to redeployment.

Animal processing – Captured animals were processed and released within 15 minutes of removal from the trap. For each animal captured, we recorded species, sex, age (adult or juvenile), and reproductive condition, if evident. The following data were gathered from each *Z. hudsonius*: mass (g); tail length (mm); hind-foot length (mm); GPS coordinates of capture locality (lat./long; dd.dddd/-ddd.dddd); detailed road directions to capture locality; detailed description of surrounding habitat (digital photographs, general habitat description, dominant overstory plant community, dominant understory plant community); and a photograph of each animal. At genetic sampling sites, 2 to 3 tissue samples were taken from the ears of all *Z. hudsonius*, using a biopsy punch (2mm diameter), and stored in 1.5 ml plastic vials containing 95% ethanol with no denaturants. Tissue vials were kept on ice during field sampling and then refrigerated for 24 hours before overnight shipment to the USGS Leetown Science Center for genetic analysis. In addition, incidental blood (DNA) from tissue punches in ears was absorbed on Whatman FTA cards (Whatman Inc., Florham Park, New Jersey). These blood samples were sent with tissues from ear punches to Leetown Science Center. Holes from tissue sampling were apparent on the ears of several individuals that we recaptured > 1 month after marking. Therefore, we are confident that animals were not sampled more than once during our surveys.

Voucher specimens - Two to four voucher specimens were taken from sites at which extensive genetic sampling occurred (e.g., > 15 individuals). All voucher specimens were deposited in the U.S. Geological Survey, Biological Survey Collection at the Museum of Southwestern Biology, University of New Mexico, Albuquerque, NM. Animals were sacrificed by thoracic compression, as recommended by the American Society of Mammalogists Animal Care and Use Guidelines. All vouchers were prepared as study skins with skulls, and carcasses were preserved in 95% alcohol.

## RESULTS AND DISCUSSION

During the summer of 2005, we spent a total of 51 nights trapping at 26 different localities, for a total of 14,568 trap nights (Table 1; Appendices D and E). Meadow jumping mice were captured at 54% ( $n = 14$ ) of the localities we trapped, for a total of 158 individuals (Table 1; Appendix F). We succeeded in capturing 30 or more *Z. hudsonius* at 4 of the 6 genetic sampling sites. These sites were: Site 1) the Bear Lodge Mountains; Site 2) the Black Hills; Site 5) Sand Lake National Wildlife Refuge, SD; and Site 6) Kearney, NE. We acquired more than half of the sample ( $n = 16$ ) from Site 4) Lacreek National Wildlife Refuge, SD and Sites 3a, 3b, 3c, and 3d (Fig. 1; Appendix D) yielded only a single individual between them.

In addition to the genetic sampling sites in the Black Hills and Bear Lodge Mountains, we trapped 3 additional localities of historical occurrence (Fig. 2). Meadow jumping mice were caught at all historical localities that we sampled in the Black Hills and Bear

Lodge Mountains, with capture frequency at these sites ranging between 8.1 and 29.8 mice per 1000 trap nights (Fig. 2). These capture rates approximate or exceed those reported from other studies in the region (Turner 1974, Duckwitz 2001). For example, Duckwitz (2001) reported mean capture rates for *Z. hudsonius* of 4.8 and 7.2 per 1000 trap nights in boxelder/chokecherry and birch/aspen habitats, respectively, at Wind Cave National Park in the southern Black Hills. Our relatively high rates of capture likely reflect only trapping within riparian habitats and searching within those habitats for what we believed to be the most ideal areas for *Z. hudsonius*. Differences in capture frequency between studies probably result from inherent biases of trapping conducted during different years using different protocols rather than representing any ecologically meaningful pattern.

We did not catch *Z. hudsonius* at 12 of the localities we trapped (Table 1). Four of these places were within 10 km of other localities at which jumping mice were captured during 2005 and four had no prior records of jumping mice occurrence. The remaining four localities where we did not catch *Z. hudsonius* were in Carter County, Montana. Because our main objective during the summer of 2005 was to obtain genetic samples rather than establish occurrence at each locality, we usually abandoned an area after 1 or 2 days of unsuccessful trapping. Protocols established by the USFWS for trapping *Z. h. preblei* (USFWS 2004b) call for at least three nights of trapping at a site to reasonably assess presence of the species. Applying USFWS standards, we are unable to conclude that *Z. hudsonius* did not occur in any of the areas where we did not catch them during the summer of 2005.



It is unclear why our trapping success was lower than past efforts at Lacreek National Wildlife Refuge and in Carter County, Montana (Lampe et al. 1974; Wilhelm et al. 1981). Potential factors that might have influenced our low capture success include local drought (Fig. 5), natural population fluctuations (Blair 1940, Quimby 1951, Meaney et al. 2003), wildfire (e.g., Long Pine Hills), and/or changes in land management practices (e.g., grazing and prescribed fire at Lacreek NWR).

At all localities, *Z. hudsonius* was captured in riparian or marshy habitats within 100 m of standing or running water and all captures occurred on or near noticeably moist soil. Species composition of predominant vegetation varied across localities (see Appendices A and C for details), but typically consisted of tall grasses, sedges, forbs, cattails, and shrubs. An overstory of deciduous or coniferous trees was usually present in the immediate area, although these shrubby and forested areas often were situated > 100 m from where captures occurred. Several localities where jumping mice were captured had been grazed by livestock during previous years (e.g., Whitelaw Creek) or were being grazed by livestock at the time of trapping (e.g., Lacreek NWR).

The sex ratio of captured *Z. hudsonius* was heavily biased toward males during May (12:1 [M:F],  $n = 81$ ) but this trend changed in June (1:1,  $n = 59$ ) and July (1:1,  $n = 44$ ). The sex ratio of the few captures that occurred during August was biased toward females (0.2:1.0,  $n = 11$ ). Pregnant and active juvenile *Z. hudsonius* were first detected on 6/12; after this date, 50% of the females that we captured showed visible signs of reproduction

(pregnancy, lactation, post-lactation). Male-skewed sex ratios during spring and early summer have been observed elsewhere and likely indicate the emergence of males from hibernation before females (Whitaker 1972). A female-biased sex ratio during August may be the result of such factors as higher survival rates of females during summer (Meaney et al. 2003) or dispersal of males to other areas (Blair 1940).

We observed enough variation in external characteristics (e.g., size and pelage color) of *Z. hudsonius* within each site to obscure our judgment of any consistent differences that may actually occur between sites or subspecies.

Individual *Z. hudsonius* were recaptured (determined by marks on ears from tissue sampling) on 15 occasions. Most recaptures occurred within 1 to 2 days of initial capture, but 3 occurred after at least 29 days and another occurred after 45 days. In the latter instances of recapture, there was little evidence that the holes created from skin biopsies had scarred closed. Because we regularly recaptured mice when re-trapping an area, it is our general impression that *Z. hudsonius* is not wary of entering Sherman live traps.

Other species captured in association with *Z. hudsonius* included: shrews (*Sorex spp.* and *Blarina brevicauda*), eastern cottontail rabbits (*Sylvilagus floridanus*), least chipmunks (*Neotamias minimus*), thirteen-lined ground squirrels (*Spermophilus tridecemlineatus*), western harvest mice (*Reithrodontomys megalotis*), white-footed mice (*Peromyscus leucopus*), deer mice (*P. maniculatus*), bushy-tailed woodrats (*Neotoma cinerea*),

southern red-backed voles (*Clethrionomys gapperi*), long-tailed voles (*Microtus longicaudus*), prairie voles (*M. ochrogaster*), meadow voles (*M. pennsylvanicus*), pocket mice (*Perognathus spp.* and *Chaetodipus hispidus*), and a short-tailed weasel (*Mustela erminea*). See Appendices D and E for capture numbers. Although traps were sometimes disturbed and prematurely sprung by raccoons (*Procyon lotor*), we saw no direct evidence of predation on animals within traps.

At all trapping localities, *Z. hudsonius* was among the 4 most frequently captured species, with the other common species being *M. pennsylvanicus*, *P. leucopus*, and *P. maniculatus*. Among genetic sampling sites, *Z. hudsonius* was captured more frequently than all other species in the Bear Lodge Mountains and at Sand Lake National Wildlife Refuge (Fig. 3). In the Black Hills of South Dakota, *Z. hudsonius* and *M. pennsylvanicus* were the two most frequently captured rodent species in the riparian habitats (Figs. 3 & 4). The relatively high number of *Z. hudsonius* and *M. pennsylvanicus* captured during this study likely reflects their affinity for the mesic habitats on which we focused our trapping efforts.

Although our trapping protocol did not allow us to determine the time of most captures, on three occasions we observed meadow jumping mice entering traps between sunset and midnight. Meadow jumping mice are known to be active mostly at night, although diurnal and crepuscular activity has been documented as well (Whitaker 1963).

## SUMMARY

We found *Z. hudsonius* to be a relatively common inhabitant at many of the localities we sampled. This finding is not surprising, as the main objective of our work was to collect numerous genetic samples and we specifically targeted areas and habitat types where the species had been previously captured in relatively high numbers.

Trapping at some of the historical localities in the Black Hills and Bear Lodge Mountains revealed that *Z. hudsonius* still occurs throughout the region.

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Table 1. Capture data from all localities trapped for *Zapus hudsonius* during the summer of 2005. Capture localities are arranged alphabetically by state, county, and location name. Values reported for each locality are: total number of nights trapped; total number of traps deployed; total number of *Z. hudsonius* (ZAHU) captured; and total number of *Z. hudsonius* captured per 1000 trap nights (1 trap night = 1 trap deployed for 1 night).

Location and Name	Nights Trapped	Total No. of Traps	No. ZAHU	ZAHU/1000 Trap Nights
Montana, Carter County, Lantis Springs	2	190	0	0.0
Montana, Carter County, McNab Pond	2	320	0	0.0
Montana, Carter County, Picnic Springs	1	240	0	0.0
Montana, Carter County, Stagville Springs	1	240	0	0.0
Nebraska, Buffalo and Kearney County, Fort Kearney SRA	5	1,580	31	19.6
South Dakota, Bennett County, Brown Ranch	1	160	0	0.0
South Dakota, Bennett County, Elm Creek	2	600	2	3.3
South Dakota, Bennett County, Little White River SRA	1	440	0	0.0
South Dakota, Bennett County, Pelican Island area	2	600	0	0.0
South Dakota, Bennett County, Trout Ponds	7	2,040	15	7.4
South Dakota, Bennett County, Visitor's Center Tree Row	1	483	1	2.1
South Dakota, Bon Homme County, Springfield GPA	2	320	0	0.0
South Dakota, Bon Homme County, Springfield SRA	2	320	0	0.0
South Dakota, Brown County, Columbia SRA	1	440	23	52.3
South Dakota, Brown County, Visitor's Center	1	320	7	21.9
South Dakota, Brown County, Weismantle Grade	1	320	2	6.3
South Dakota, Custer County, Lower Iron Creek	3	1,040	22	21.2
South Dakota, Custer County, Iron Creek	2	355	0	0.0
South Dakota, Dewey County, Little Moreau SRA	1	320	0	0.0
South Dakota, Lawrence County, Boxelder Forks CG	1	320	4	12.5
South Dakota, Pennington County, Beaver Creek CG	1	320	7	21.9
South Dakota, Pennington County, Ditch Creek CG	1	320	3	9.4
South Dakota, Pennington County, Willow Creek CG	4	1,240	10	8.1
South Dakota, Perkins County, Shadehill SRA	1	320	0	0.0
Wyoming, Crook County, Beaver Creek	2	680	11	16.2
Wyoming, Crook County, Whitelaw Creek	3	1,040	20	19.2
ALL SITES COMBINED	51	14,568	158	10.8

Figure 1. Sites at which trapping efforts to collect genetic samples from *Zapus hudsonius* were attempted during the summer of 2005. General site localities are as follows: 1) Bear Lodge Mountains, Crook Co., WY; 2) Black Hills, Custer Co. and Pennington Co., SD; 3a) Ekalaka/Long Pine Hills, Carter Co., MT; 3b) Shadehill State Recreation Area, Perkins Co., SD; 3c) Little Moreau State Recreation Area, Dewey Co., SD; 3d) Springfield State Recreation Area, Bon Homme, SD; 4) Lacreek National Wildlife Refuge, Bennett Co., South Dakota; 5) Sand Lake National Wildlife Refuge, Brown Co., SD; and 6) Fort Kearney State Recreation Area, Kearney Co. and Buffalo Co., NE. Vertical hatching represents the range of *Z. h. campestris*, diagonal hatching is *Z. h. intermedius*, and the crosshatching shows the range of *Z. h. pallidus*, as depicted by Krutzsch (1954).

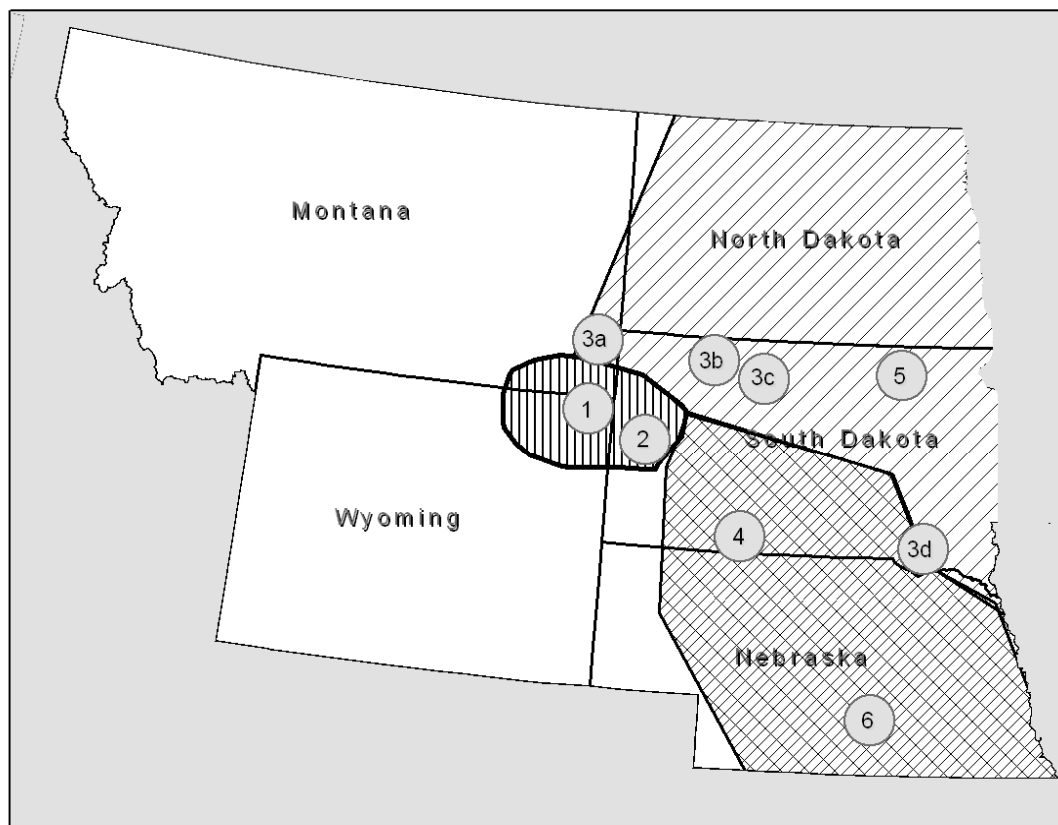


Figure 2. Locations of historical occurrence of *Zapus hudsonius* in the Black Hills region that were revisited and trapped during the summer of 2005. The number of *Z. hudsonius* captured per 1000 trap nights at each locality during 2005 is displayed above each locality name. Asterisks after names indicate localities of historical occurrence where genetic sampling did not occur during summer of 2005.

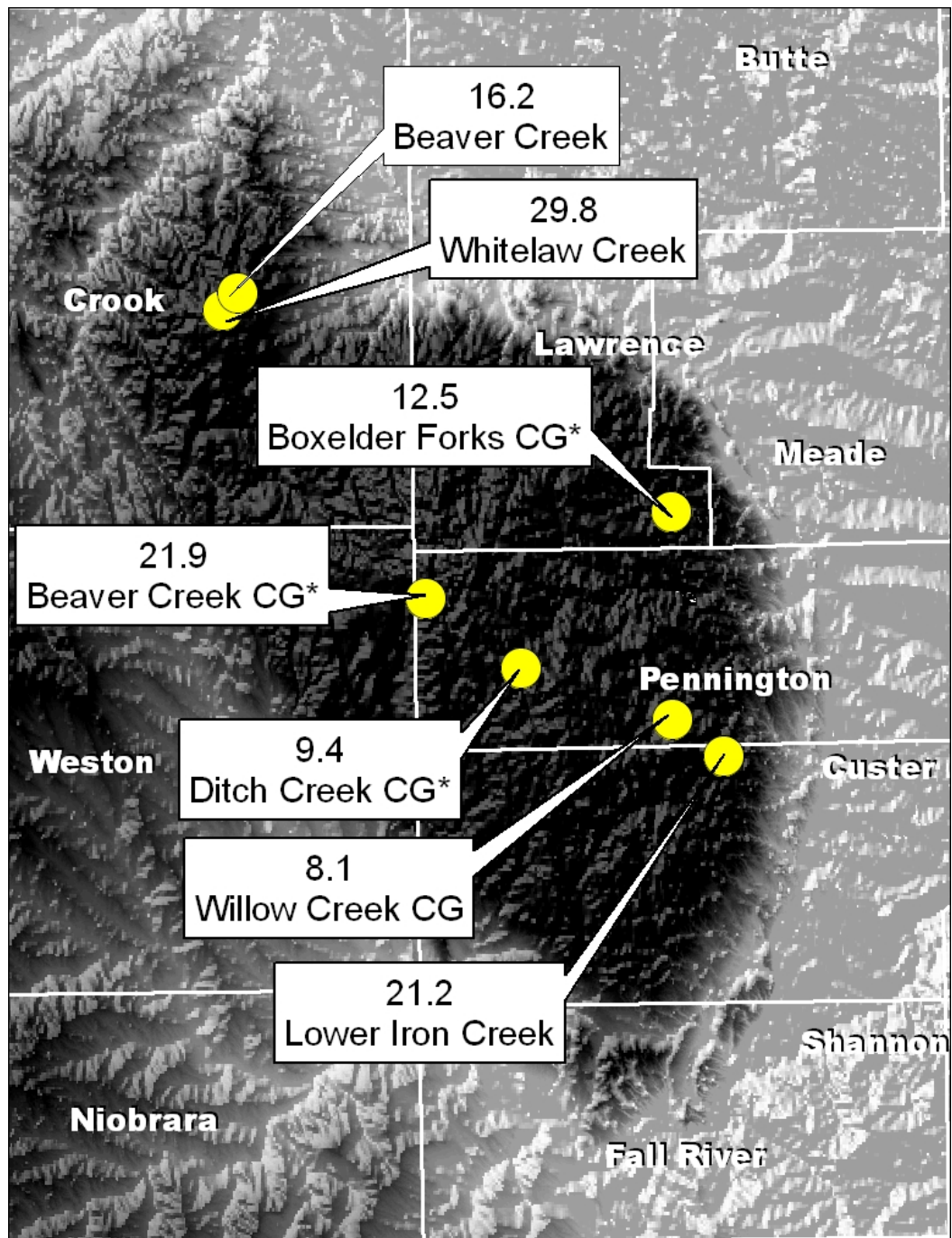


Figure 3. Relative capture frequency of the four rodent species trapped most often at genetic sampling sites 1, 2, 4, 5, and 6. Frequencies reported as number of animals per 1000 trap nights. Four-letter species codes are as follows: PELE (*Peromyscus leucopus*), PEMA (*Peromyscus maniculatus*), MIPE (*Microtus pennsylvanicus*), and ZAHU (*Zapus hudsonius*).

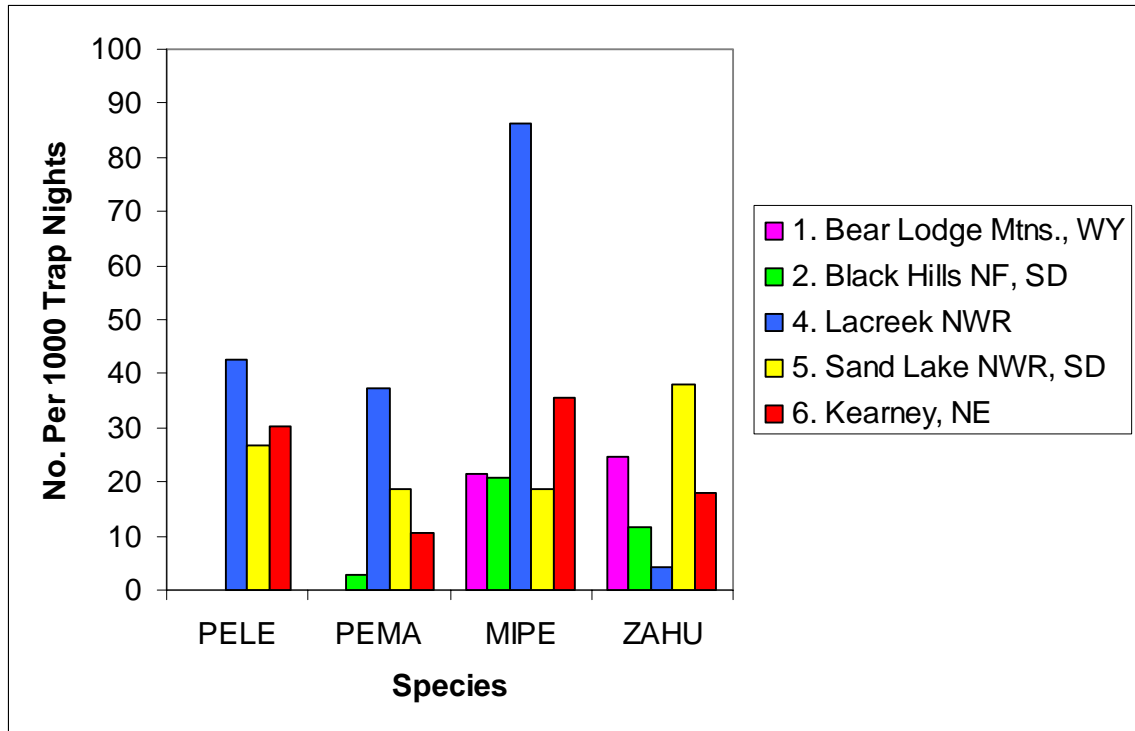


Figure 4. Relative capture frequencies of the four rodent species trapped most often at historical occurrence localities of *Z. hudsonius* in the Black Hills region. Frequencies reported as number of animals per 1000 trap nights. Four-letter species codes are as follows: PELE (*Peromyscus leucopus*), PEMA (*Peromyscus maniculatus*), MIPE (*Microtus pennsylvanicus*), and ZAHU (*Zapus hudsonius*).

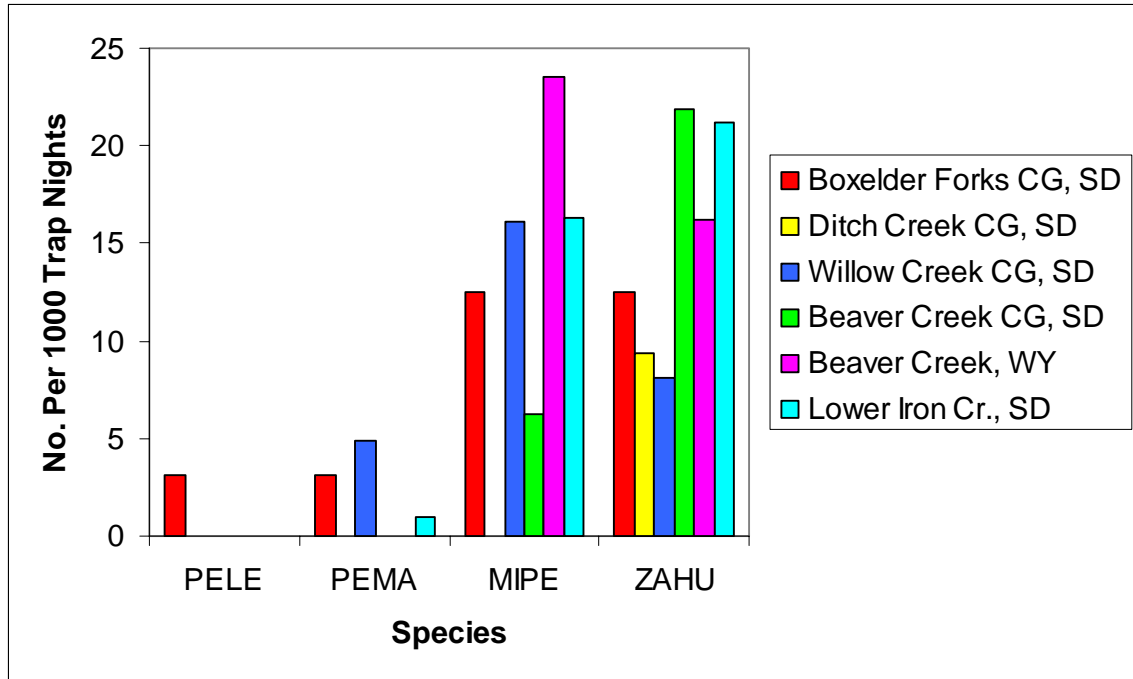
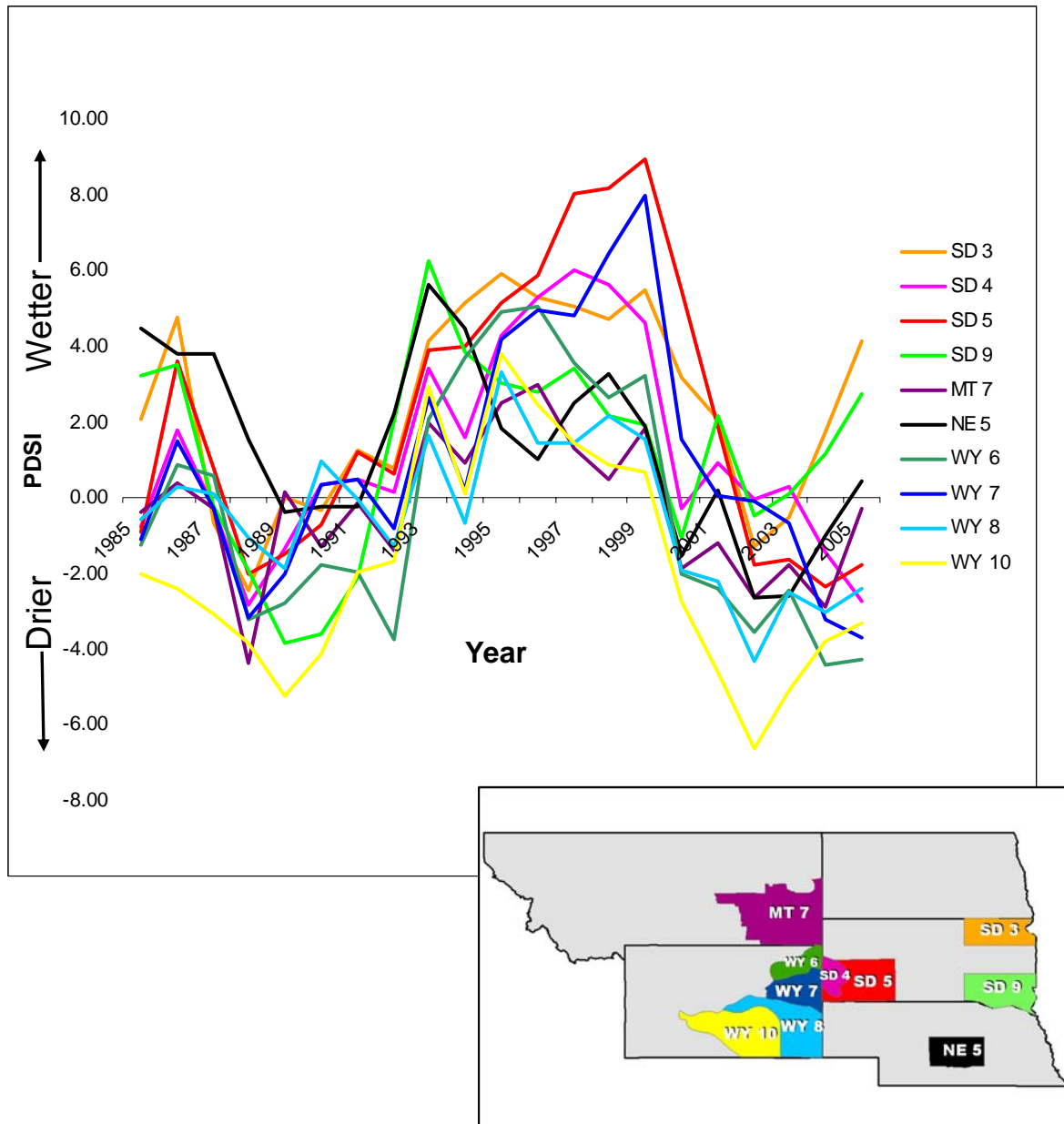


Figure 5. Palmer Drought Severity Index (PDSI) values for select climate zones around the Black Hills and Northern Great Plains between 1985 and spring of 2005. Annual values represent 12-month averages, except 2005, for which only data from January through July were available. Negative values represent drought conditions, as classified by the National Climate Data Center: 0.0 to -0.5 = normal conditions; -0.5 to -1.0 = incipient drought; -1.0 to -2.0 = mild drought; -2.0 to -3.0 = moderate drought; -3.0 to -4.0 = severe drought; > -4.0 = extreme drought. Climate zones shown on inset map are color-coded to match corresponding lines on graph. Data available online from the NCDC at: <http://www1.ncdc.noaa.gov/pub/data/cirs/>



Appendix A. Descriptions of localities where USGS field crews trapped for *Zapus hudsonius* during the summer of 2005. Site numbers 1 through 6 correspond to the genetic sampling sites depicted in Figure 1. Localities marked with an asterisk were both historical localities and situated within genetic sampling sites. Dates that localities were trapped during 2005 are shown in parentheses.

### **Site 1 - Bear Lodge Mountains, Wyoming**

Whitelaw Creek, Black Hills National Forest\* (5/24/05-5/26/05): perennial riparian stream surrounded by ponderosa pine/birch forest and open meadows with shrubs, sedges, and grasses. To reach Whitelaw Creek from Sundance, WY, drive 2.7 miles west on Highway 14 then on north on forest road 838 for 10 miles to the junction of SUNW20 and forest road 838.

Beaver Creek, Black Hills National Forest\* (5/27/05 and 7/01/05): perennial riparian stream surrounded by ponderosa pine/birch forest and open meadows in Ledogar Flats. Site is near where forest road 841 crosses the creek and is approximately 3 miles north-northeast of Warren Peak (by air).

### **Site 2 - Black Hills, South Dakota**

Iron Creek, Black Hills National Forest (05/28/05): perennial stream running through grassy meadows surrounded by ponderosa pine forest. Willows border the stream banks in several areas. This site is where Iron Creek runs through Iron Creek Campground, approximately 6 miles north and 6 miles east of Custer (by air). To reach this site from Highway 16 on the east side of Custer, drive north on Highway 89 for 6.1 miles, east on Highway 87 for 8.1 miles, then north on 345 for 0.6 miles to the fork, staying left, continue 0.3 miles to the campground.

Lower Iron Creek, Black Hills National Forest\* (05/29/05-05/30/05 and 6/30/05): perennial stream with associated riparian forest that passes below steep rock slopes of ponderosa pine forest. To reach the site from Highway 16 on the east side of Custer, drive north on Highway 89 for 6.1 miles, east on Highway 87 for 8.1 miles, then north on 345 for 0.6 miles to the fork, staying right, continue for approximately 2.2 miles to start of where our trap lines began.

Willow Creek Campground, Black Hills National Forest\* (5/31/05-6/01/05, 6/28/05-6/29/05): site of 2 perennial streams, Willow and Palmer Creeks. The dominant vegetation is comprised of forested ponderosa pine slopes surrounding riparian streamside vegetation and grassy open meadows along the creeks. Willow Creek Campground is reached by driving 3.2 miles east of Highway 16 on Highway 244 (campground entrance on the south side of the road).

### **Site 3a – Carter Co., Southwestern Montana**

## Appendix A. Trapping Sites (continued)

Lantis Spring Campground, Custer National Forest\* (6/21/05, 6/22/05): spring situated in the Long Pine Hills amidst the remains of a catastrophically burned ponderosa pine forest. Few live trees remain in the area, except in sheltered gullies that intersect the rolling hills. Vegetation in the gullies around Lantis Spring was comprised of cattails, grasses, sedges, bulrush, and moss. To reach Lantis Spring Campground, drive 3.2 miles west then south of Camp Crook on Highway 20 to Creek Road. Continue west on Creek Road for 8.3 miles to forest road 3119 (cutting north at the 90° bend), drive 1.8 miles north on forest road 3119, turn left at the Y, continue 1.9 miles to forest road 3117. Follow forest road 3117 for 1.4 miles to the entrance of the Lantis Spring Campground.

Picnic Spring, Custer National Forest (6/22/05): spring is approximately 3 miles southeast of Lantis Spring in the Long Pine Hills and approximately 10 miles northwest Camp Crook, South Dakota (by air). Picnic Spring feeds a short stretch of stream with its associated ponds and marshy areas. Wet areas around the spring are bordered by riparian vegetation (cattails, willows, sedges) and situated amid ponderosa pine forest on the higher slopes. To reach Picnic Spring from the Lantis Spring Campground entrance, drive 0.7 miles south to the intersection, then east for 1.4 miles before turning left onto forest road 3118 and continuing 1.1 miles to spring.

Stagville Springs, Custer National Forest (6/24/05): springs are found in Stagville Draw of the Ekalaka Hills, approximately 5 miles south-southeast of Ekalaka (by air). The springs feed beaver ponds that support riparian vegetation in the bottom of draw, with ponderosa pine forest on the higher slopes. To reach this site drive 4 miles north along forest road 323 from the Prairie Dale Road, then west on forest road 3813 into Stagville Draw. The beaver ponds are located on the east side of forest road 3813, 3.2 miles from forest road 323.

McNab Pond, Custer National Forest (6/23/05-6/24/05): pond is approximately 7 miles southeast of Ekalaka (by air) in the Ekalaka Hills. The pond is surrounded by cattails, grassy meadows, and ponderosa pine forested slopes. To reach McNab Pond, drive south of Ekalaka on forest road 323 to the Prairie Dale Road, then east on Prairie Dale Road approximately 1/2 mile to a dirt road heading north. Follow the dirt road for several hundred meters to the picnic area and pond.

### **Site 3b & 3c - North central South Dakota**

Little Moreau State Recreation Area (08/03/05): reservoir located along the Little Moreau River in Dewey County. Trapping occurred in the riparian habitats (tall grasses, cattails, deciduous forest) that surround the river and reservoir. To reach the site from Timber Lake, drive south on the road to White Horse for 7 miles to the entrance of the recreation area.

Shadehill State Recreation Area (08/04/05): reservoir at the confluence of the north and south forks of the Grand River. Surrounding habitat is primarily grasslands and crops, but lush riparian vegetation borders the reservoir and river. To reach this site, follow the road that cuts east from Shadehill for approximately 100 meters to the entrance of the



## Appendix A. Trapping Sites (continued)

Llwellyn Johns Campground. Traps were set along the edge of the reservoir adjacent to the campground. To reach the site trapped by PMC and BDS, drive 0.5 miles south of where the Grand River passes beneath Highway 73, then west for 1.1 miles to a dirt track that cuts north to the stretch of river below the dam.

### **Site 3d - Southeastern South Dakota**

Springfield State Recreation Area (8/16/05, 8/19/05): perennial stream that feeds into the Missouri River near the town of Springfield. Trapping occurred in riparian vegetation along a stream running through the recreation area and into the Missouri River. The stream was located on the northwest border of the northernmost campground. Surrounding habitat included mown lawns, grassy forested slopes, and crop fields. The recreation area can be reached by driving 4 blocks east of downtown Springfield.

Springfield Game Production Area (08/17/05-08/18/05): marshy area located along the Missouri River between the towns of Running Water (West) and Springfield (East). Predominant vegetation at the site was tall grasses, sedges, cattails, bulrush, and willows. The area trapped is reached by driving 1.0 miles west of Springfield on 37 then turning south on county road 22 for 1 to 6 miles.

### **Site 4 - South central South Dakota**

Pelican Island area (06/07/05 and 07/12/05): pond and adjacent marsh at Lacreek National Wildlife Refuge (NWR). Willows, cattails, tall grasses, and bulrush thickets comprise the vegetation found along edges of ponds and wet meadows. The site is reached by driving 3.1 miles east of the refuge headquarters to where the road passes between pools #9 and #10.

Trout Ponds, Lacreek NWR (06/08/05-06/09/05, 07/13/05-07/15/05, 07/24/05-07/25/05): ponds formed by Cedar Creek and surrounded by marsh and patches of deciduous forest. To reach the ponds drive 3.2 miles west of refuge headquarters to the road that runs south past the cemetery. Follow the cemetery road for 2.5 miles to the fork then continue right (south) for approximately 0.3 miles.

Elm Creek, Lacreek NWR (06/10/05 and 08/09/05): perennial riparian stream running south of pool #8. Cattail marshes and patches of riparian forest surround pools and thick stands of willow and grass that border the flowing stream. To reach this site, drive 3.8 miles south from the main refuge road to the point where the Elm Creek passes beneath the road.

Little White River Recreation Area (06/14/05): riverside picnic area situated beneath riparian forest at the edge of the Little White River and its associated cattail marsh. This site is found on the north end of Lacreek National Wildlife Refuge. Surrounding habitat consists of grasslands and mown lawns.

## Appendix A. Trapping Sites (continued)

Visitor Center Tree Row, Lacreek NWR (06/15/05 and 08/12/05): shelter belt of trees along the east side of the dike road that runs south from the visitor center. This shelter belt, comprised mostly of elms and cottonwoods, separates the dike road from marshy areas and open water to the east. This site is reached by driving approximately 0.6 miles south of the visitor center along the tour route road, just past the first small metal bridge.

Brown Ranch, Lacreek NWR (08/11/05): wet meadow and marshy area surrounded by grasslands. To reach this site drive 5.3 miles west of the refuge headquarters to the road that heads south (three posts), then approximately 1.8 miles to the meadow adjacent to the second 90° bend in the road.

### **Site 5 - Northwestern South Dakota**

Weismantle Grade (6/11/05): dike road across Sand Lake at the south end of Sand Lake NWR. Trapping occurred in cattail marshes at each end of Weismantle Grade. To reach this site drive south of the refuge visitor center on Hwy 16 about 3.5 miles to where the grade crosses Sand Lake.

Columbia Recreation Area (6/12/05): lakeside picnic area located approximately one mile south of the visitor center at Sand Lake NWR. Surrounding habitat included deciduous forest, grassy meadows, cattail marshes, and lakeside forbs. To reach this site drive one mile south of the visitor center on county road 16.

Visitor Center (6/13/05): shelter belt and surrounding grassland along county road 16, adjacent to the road entrance of the Sand Lake NWR Visitor Center.

### **Site 6 - Central Nebraska**

Fort Kearney Recreation Area and Bassway Strip (07/19/05-07/23/05): riverside habitat along the North Platte River and its associated tributaries and ponds. Predominant vegetation included deciduous riparian forest, cattails, bulrush, grasses, sedges, and forbs. To reach the Fort Kearney Recreation area take exit #279 of I-80, turn south and follow road signs to the recreation area. The Bassway Strip is located off of the same exit (#279), but east along the first road before the bridge spanning the North Platte River. The Bassway Strip runs parallel to eastbound I-80.

### **Additional historical sites- Black Hills National Forest**

Boxelder Forks Campground (07/26/05): perennial stream with associated riparian vegetation running through spruce forest. Boxelder Campground is located near Nemo, South Dakota (approximately 2 miles northwest of Nemo [by air]).

Ditch Creek (08/02/05): perennial stream surrounded by riparian vegetation running through spruce forest. Trapping occurred both upstream and downstream of the Ditch Creek Campground. To reach Ditch Creek Campground, begin at Hill City and drive 17.1 miles west on 308, then south on 241 for 4.4 miles to the campground.

## Appendix A. Trapping Sites (continued)

Beaver Creek Campground (08/05/05): perennial stream surrounded by riparian vegetation running through mixed conifer forest. Trapping occurred both upstream and downstream from the Beaver Creek Campground. To reach this site, from Four Corners drive 4.5 miles east on forest road 881 then turn left at the intersection and continue 0.5 miles farther (left of the cabins) before proceeding another 1.6 miles to the campground.

Appendix B. Detail maps of sites where USGS crews trapped for *Zapus hudsonius* during the summer of 2005. Listed above each map is the locality name, county, region, and state. All details are of USGS 7.5' quadrangle maps (1:24,000), with the name of the quadrangle listed in *italics* below each site name. Pairs of colored dots represent both ends trap lines.

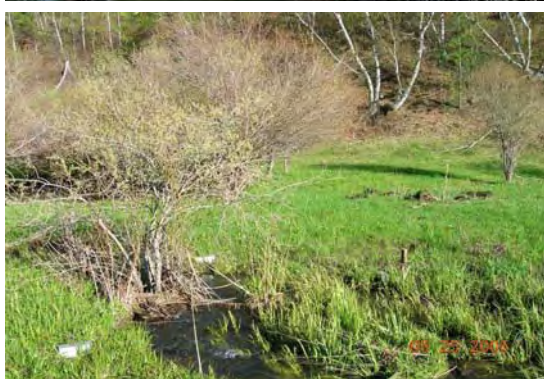
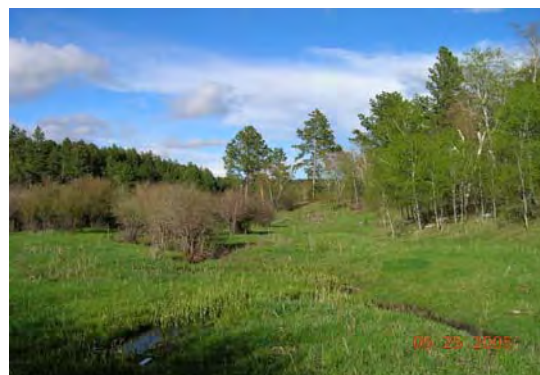
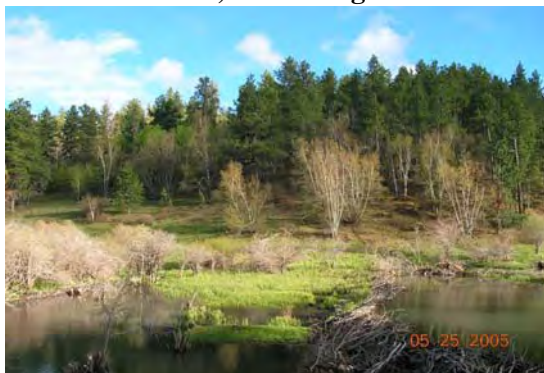
Beaver Creek Campground, Pennington Co., Black Hills, South Dakota.  
*Parmlee Canyon*





Appendix C. Photographs of localities and representative habitat where *Zapus hudsonius* was captured during the summer of 2005

**Whitelaw Creek, Bear Lodge Mountains**



**Beaver Creek, Bear Lodge Mountains**





## Appendix C. Habitat Photos (Continued)

### Lower Iron Creek, Black Hills, South Dakota



### Willow Creek, Black Hills, South Dakota



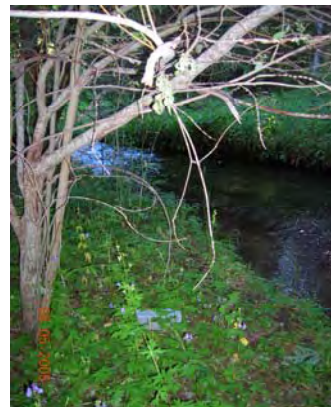


Appendix C. Habitat Photos (Continued)

**Ditch Creek, Black Hills, South Dakota**



**Beaver Creek Campground, Black Hills, South Dakota**





## Appendix C. Habitat Photos (Continued)

### Elm Creek, Lacreek National Wildlife Refuge, South Dakota



### Trout Ponds, Lacreek National Wildlife Refuge, South Dakota





Appendix C. Habitat Photos (Continued)

**Columbia Recreation Area, Sand Lake National Wildlife Refuge, South Dakota**



**Bassway Strip, Kearney, Nebraska**



Appendix D. Capture data from genetic sampling sites trapped by USGS field crews during the summer of 2005. Site numbers and names correspond to those shown in Figure 1. Numbers in parantheses after species name indicate genetic sample numbers.

Site Name	Dates Sampled (2005)			Total # of Trap Nights	
Site 1: Bear Lodge Mountains, WY	5/24-5/27, 7/1			1720	
Species Captured	Male	Female	Unknown	Total # of Animals Trapped	Total # Animals Per 1000 Trap Nights
<i>Sorex Spp</i>	.	.	.	0	0.0
<i>Blarina brevicauda</i>	.	.	.	0	0.0
<i>Neotamias minimus</i>	4	.	.	4	2.3
<i>Spermophilus tridecemlineatus</i>	.	.	.	0	0.0
<i>Reithrodontomys megalotis</i>	.	.	.	0	0.0
<i>Peromyscus leucopus</i>	.	.	.	0	0.0
<i>Peromyscus maniculatus</i>	.	.	.	0	0.0
<i>Clethrionomys gapperi</i>	4	6	1	11	6.4
<i>Microtus longicaudus</i>	1	1	.	2	1.2
<i>Microtus ochrogaster</i>	.	.	.	0	0.0
<i>Microtus pennsylvanicus</i>	17	19	1	37	21.5
<i>Zapus hudsonius</i> (ZAHU 001-028, 106-108)	39	3	.	42	24.5
Site Name	Dates Sampled (2005)			Total # of Trap Nights	
Site 2: Black Hills, SD	5/28-6/01, 6/28-6/30			2635	
Species Captured	Male	Female	Unknown	Total # of Animals Trapped	Total # Animals/1000 Trap Nights
<i>Sorex Spp</i>	.	2	7	9	3.4
<i>Blarina brevicauda</i>	.	.	.	0	0.0
<i>Neotamias minimus</i>	1	1	.	2	0.8
<i>Spermophilus tridecemlineatus</i>	.	1	.	1	0.4
<i>Perognathus Spp</i>	1	.	.	1	0.4
<i>Reithrodontomys megalotis</i>	.	.	1	1	0.4
<i>Peromyscus leucopus</i>	.	.	.	0	0.0
<i>Peromyscus maniculatus</i>	4	3	.	7	2.7
<i>Clethrionomys gapperi</i>	20	5	.	25	9.5
<i>Microtus longicaudus</i>	4	4	.	8	3.0
<i>Microtus ochrogaster</i>	.	.	.	0	0.0
<i>Microtus pennsylvanicus</i>	32	23	.	55	20.9
<i>Zapus hudsonius</i> (ZAHU 029-050, 098-102)	25	6	.	31	11.8
<i>Mustela erminea</i>	.	.	1	1	0.4

Appendix D. Trapping Data from Genetic Sampling Sites (continued)

Site Name		Dates Sampled (2005)			Total # of Trap Nights
Site 3a: Ekalaka/Lone Pine Hills, MT		6/21-6/24			990
Species Captured	Male	Female	Unknown	Total # of Animals Trapped	Total # Animals/1000 Trap Nights
<i>Sorex Spp</i>	.	.	.	0	0.0
<i>Blarina brevicauda</i>	.	.	.	0	0.0
<i>Neotamias minimus</i>	.	.	.	0	0.0
<i>Spermophilus tridecemlineatus</i>	.	.	.	0	0.0
<i>Reithrodontomys megalotis</i>	.	.	.	0	0.0
<i>Peromyscus leucopus</i>	1	1	.	2	2.0
<i>Peromyscus maniculatus</i>	14	20	1	35	35.4
<i>Clethrionomys gapperi</i>	.	.	.	0	0.0
<i>Microtus longicaudus</i>	.	.	.	0	0.0
<i>Microtus ochrogaster</i>	.	.	.	0	0.0
<i>Microtus pennsylvanicus</i>	7	21	.	28	28.3
<i>Zapus hudsonius</i>	.	.	.	0	0.0
Site Name		Dates Sampled (2005)			Total # of Trap Nights
Sites 3b & 3c: Shadehill and Little Moreau, SD		8/3-8/4			640
Species Captured	Male	Female	Unknown	Total # of Animals Trapped	Total # Animals/1000 Trap Nights
<i>Sorex Spp</i>	.	.	.	0	0.0
<i>Blarina brevicauda</i>	.	.	.	0	0.0
<i>Neotamias minimus</i>	.	.	.	0	0.0
<i>Spermophilus tridecemlineatus</i>	.	.	.	0	0.0
<i>Chaetodipus hispidus</i>	.	1	.	1	1.6
<i>Reithrodontomys megalotis</i>	1	3	.	4	6.3
<i>Peromyscus leucopus</i>	7	4	1	12	18.8
<i>Peromyscus maniculatus</i>	10	7	.	17	26.6
<i>Mus musculus</i>	1	1	.	2	3.1
<i>Clethrionomys gapperi</i>	.	.	.	0	0.0
<i>Microtus longicaudus</i>	.	.	.	0	0.0
<i>Microtus ochrogaster</i>	2	1	.	3	4.7
<i>Microtus pennsylvanicus</i>	2	4	1	7	10.9
<i>Zapus hudsonius</i> (ZAHU 144)	.	1	.	1	1.6

Appendix D. Trapping Data from Genetic Sampling Sites (continued)

Site Name	Dates Sampled (2005)			Total # of Trap Nights	
Site 3d: Springfield, SD	8/16-8/19			640	
Species Captured	Male	Female	Unknown	Total # of Animals Trapped	Total # Animals/1000 Trap Nights
<i>Sorex Spp</i>	.	.	.	0	0.0
<i>Blarina brevicauda</i>	3	4	1	8	12.5
<i>Neotamias minimus</i>	.	.	.	0	0.0
<i>Spermophilus tridecemlineatus</i>	.	.	.	0	0.0
<i>Reithrodontomys megalotis</i>	1	1	.	2	3.1
<i>Peromyscus leucopus</i>	9	4	.	13	20.3
<i>Peromyscus maniculatus</i>	1	1	.	2	3.1
<i>Clethrionomys gapperi</i>	.	.	.	0	0.0
<i>Microtus longicaudus</i>	.	.	.	0	0.0
<i>Microtus ochrogaster</i>	2	1	.	4	6.3
<i>Microtus pennsylvanicus</i>	.	1	.	1	1.6
<i>Zapus hudsonius</i>	.	.	.	0	0.0

Site Name	Dates Sampled (2005)			Total # of Trap Nights	
Site 4: Lacreek NWR, SD	6/7-6/10, 6/14-6/15, 7/12-7/15, 7/24-7/25, 8/9-8/12			4323	
Species Captured	Male	Female	Unknown	Total # of Animals Trapped	Total # Animals/1000 Trap Nights
<i>Sorex Spp</i>	1	1	9	11	2.5
<i>Blarina brevicauda</i>	.	.	.	0	0.0
<i>Neotamias minimus</i>	.	.	.	0	0.0
<i>Spermophilus tridecemlineatus</i>	.	.	.	0	0.0
<i>Reithrodontomys megalotis</i>	22	21	1	44	10.2
<i>Peromyscus leucopus</i>	103	81	.	184	42.6
<i>Peromyscus maniculatus</i>	93	63	6	162	37.5
<i>Clethrionomys gapperi</i>	.	.	.	0	0.0
<i>Microtus longicaudus</i>	5	7	.	12	2.8
<i>Microtus ochrogaster</i>	14	18	.	32	7.4
<i>Microtus pennsylvanicus</i>	172	196	5	373	86.3
<i>Zapus hudsonius</i> (ZAHU 052-064, 097,109-111)	9	9	.	18	4.2

Appendix D. Trapping Data from Genetic Sampling Sites (continued)

Site Name	Dates Sampled (2005)			Total # of Trap Nights	
Site 5: Sand Lake NWR, SD	6/11-6/13			1080	
Species Captured	Male	Female	Unknown	Total # of Animals Trapped	Total # Animals/1000 Trap Nights
<i>Sorex Spp</i>	.	.	.	0	0.0
<i>Blarina brevicauda</i>	1	.	.	1	0.9
<i>Sylvilagus floridanus</i>	1	1	2	4	3.7
<i>Blarina brevicauda</i>	1	.	.	1	0.9
<i>Neotamias minimus</i>	.	.	.	0	0.0
<i>Spermophilus tridecemlineatus</i>	.	.	1	1	0.9
<i>Reithrodontomys megalotis</i>	3	.	1	4	3.7
<i>Peromyscus leucopus</i>	16	13	.	29	26.9
<i>Peromyscus maniculatus</i>	11	8	1	20	18.5
<i>Clethrionomys gapperi</i>	.	.	.	0	0.0
<i>Microtus longicaudus</i>	.	.	.	0	0.0
<i>Microtus ochrogaster</i>	.	.	.	0	0.0
<i>Microtus pennsylvanicus</i>	8	12	.	20	18.5
<i>Zapus hudsonius</i> (ZAHU 065-096)	29	12	.	41	38.0

Site Name	Dates Sampled (2005)			Total # of Trap Nights	
Site 6: Kearney, Nebraska	7/19-7/23			1580	
Species Captured	Male	Female	Unknown	Total # of Animals Trapped	Total # Animals/1000 Trap Nights
<i>Sorex Spp</i>	.	.	7	7	4.4
<i>Blarina brevicauda</i>	1	1	8	10	6.3
<i>Neotamias minimus</i>	.	.	.	0	0.0
<i>Spermophilus tridecemlineatus</i>	.	.	.	0	0.0
<i>Reithrodontomys megalotis</i>	7	2	.	9	5.7
<i>Peromyscus leucopus</i>	31	23	.	54	34.2
<i>Peromyscus maniculatus</i>	12	6	1	19	12.0
<i>Clethrionomys gapperi</i>	.	.	.	0	0.0
<i>Microtus longicaudus</i>	.	.	.	0	0.0
<i>Microtus ochrogaster</i>	3	2	.	5	3.2
<i>Microtus pennsylvanicus</i>	31	32	.	63	39.9
<i>Zapus hudsonius</i> (ZAHU 112-143)	15	16	.	31	19.6

Appendix E. Capture data from localities of historical occurrence of *Zapus hudsonius* that were revisited by USGS field crews during summer of 2005. These data were also consolidated into the site totals presented in Appendix D.

Locality Name		Dates Sampled (2005)			Total # of Trap Nights	
Beaver Creek, Wyoming		5/27, 7/01			680	
Species Captured	Male	Female	Unknown	Total # of Animals Trapped	Total # Animals/1000 Trap Nights	
<i>Sorex Spp</i>	.	.	.	0	0.0	
<i>Blarina brevicauda</i>	.	.	.	0	0.0	
<i>Neotamias minimus</i>	4	.	.	4	5.9	
<i>Spermophilus tridecemlineatus</i>	.	.	.	0	0.0	
<i>Reithrodontomys megalotis</i>	.	.	.	0	0.0	
<i>Peromyscus leucopus</i>	.	.	.	0	0.0	
<i>Peromyscus maniculatus</i>	.	.	.	0	0.0	
<i>Clethrionomys gapperi</i>	3	6	1	10	14.7	
<i>Microtus longicaudus</i>	1	1	.	2	2.9	
<i>Microtus ochrogaster</i>	.	.	.	0	0.0	
<i>Microtus pennsylvanicus</i>	7	9	.	16	23.5	
<i>Zapus hudsonius</i>	10	1	.	11	16.2	

Locality Name		Dates Sampled (2005)			Total # of Trap Nights	
Whitelaw Creek, Wyoming		5/24-5/26			1040	
Species Captured	Male	Female	Unknown	Total # of Animals Trapped	Total # Animals/1000 Trap Nights	
<i>Sorex Spp</i>	.	.	.	0	0.0	
<i>Blarina brevicauda</i>	.	.	.	0	0.0	
<i>Neotamias minimus</i>	.	1	.	1	1.0	
<i>Spermophilus tridecemlineatus</i>	.	.	.	0	0.0	
<i>Reithrodontomys megalotis</i>	.	.	.	0	0.0	
<i>Peromyscus leucopus</i>	.	.	.	0	0.0	
<i>Peromyscus maniculatus</i>	.	.	.	0	0.0	
<i>Clethrionomys gapperi</i>	1	.	.	1	1.0	
<i>Microtus longicaudus</i>	.	.	.	0	0.0	
<i>Microtus ochrogaster</i>	.	.	.	0	0.0	
<i>Microtus pennsylvanicus</i>	10	9	1	20	19.2	
<i>Zapus hudsonius</i>	29	2	.	31	29.8	

Appendix E. Trapping Data from Historical Localities (continued)

Locality Name		Dates Sampled (2005)			Total # of Trap Nights
Beaver Creek Campground, South Dakota		8/5			320
Species Captured	Male	Female	Unknown	Total # of Animals Trapped	Total # Animals/1000 Trap Nights
<i>Sorex Spp</i>	.	.	.	0	0.0
<i>Blarina brevicauda</i>	.	.	.	0	0.0
<i>Neotamias minimus</i>	.	.	.	0	0.0
<i>Spermophilus tridecemlineatus</i>	.	.	.	0	0.0
<i>Reithrodontomys megalotis</i>	.	.	.	0	0.0
<i>Peromyscus leucopus</i>	.	.	.	0	0.0
<i>Peromyscus maniculatus</i>	.	.	.	0	0.0
<i>Clethrionomys gapperi</i>	.	1	.	1	3.1
<i>Microtus longicaudus</i>	.	.	.	0	0.0
<i>Microtus ochrogaster</i>	.	.	.	0	0.0
<i>Microtus pennsylvanicus</i>	.	2	.	2	6.3
<i>Zapus hudsonius</i>	2	5	.	8	21.9

Locality Name		Dates Sampled (2005)			Total # of Trap Nights
Boxelder Forks Campground, South Dakota		7/26			320
Species Captured	Male	Female	Unknown	Total # of Animals Trapped	Total # Animals/1000 Trap Nights
<i>Sorex Spp</i>	1	.	1	2	6.3
<i>Blarina brevicauda</i>	.	.	.	0	0.0
<i>Neotamias minimus</i>	.	.	.	0	0.0
<i>Spermophilus tridecemlineatus</i>	.	.	.	0	0.0
<i>Reithrodontomys megalotis</i>	.	.	.	0	0.0
<i>Peromyscus leucopus</i>	.	1	.	1	3.1
<i>Peromyscus maniculatus</i>	.	1	.	1	3.1
<i>Neotoma cinerea</i>	1	.	.	1	3.1
<i>Clethrionomys gapperi</i>	.	.	.	0	0.0
<i>Microtus longicaudus</i>	.	.	.	0	0.0
<i>Microtus ochrogaster</i>	1	1	.	2	6.3
<i>Microtus pennsylvanicus</i>	2	2	.	4	12.5
<i>Zapus hudsonius</i>	4	.	.	4	12.5

Appendix E. Trapping Data from Historical Localities (continued)

Locality Name		Dates Sampled (2005)			Total # of Trap Nights
Ditch Creek Campground, South Dakota		8/2			320
Species Captured	Male	Female	Unknown	Total # of Animals Trapped	Total # Animals/1000 Trap Nights
<i>Sorex Spp</i>	.	.	4	4	12.5
<i>Blarina brevicauda</i>	.	.	.	0	0.0
<i>Neotamias minimus</i>	.	.	.	0	0.0
<i>Spermophilus tridecemlineatus</i>	.	.	.	0	0.0
<i>Reithrodontomys megalotis</i>	.	.	.	0	0.0
<i>Peromyscus leucopus</i>	.	.	.	0	0.0
<i>Peromyscus maniculatus</i>	.	.	.	0	0.0
<i>Clethrionomys gapperi</i>	.	2	.	2	6.3
<i>Microtus longicaudus</i>	.	.	.	0	0.0
<i>Microtus ochrogaster</i>	.	.	.	0	0.0
<i>Microtus pennsylvanicus</i>	.	.	.	0	0.0
<i>Zapus hudsonius</i>	.	3	.	3	9.4
Locality Name		Dates Sampled (2005)			Total # of Trap Nights
Lower Iron Creek, South Dakota		5/29-5/30, 6/30			1040
Species Captured	Male	Female	Unknown	Total # of Animals Trapped	Total # Animals/1000 Trap Nights
<i>Sorex Spp</i>	.	.	1	1	1.0
<i>Blarina brevicauda</i>	.	.	.	0	0.0
<i>Neotamias minimus</i>	.	.	.	0	0.0
<i>Spermophilus tridecemlineatus</i>	.	1	.	1	1.0
<i>Reithrodontomys megalotis</i>	.	.	.	0	0.0
<i>Peromyscus leucopus</i>	.	.	.	0	0.0
<i>Peromyscus maniculatus</i>	1	.	.	1	1.0
<i>Clethrionomys gapperi</i>	10	2	.	12	11.5
<i>Microtus longicaudus</i>	4	1	.	5	4.8
<i>Microtus ochrogaster</i>	.	.	.	0	0.0
<i>Microtus pennsylvanicus</i>	12	5	.	17	16.3
<i>Zapus hudsonius</i>	18	4	.	22	21.2
<i>Mustela erminea</i>	.	.	1	1	1.0



Appendix E. Trapping Data from Historical Localities (continued)

Locality Name		Dates Sampled (2005)			Total # of Trap Nights
Willow Creek Campground, South Dakota		5/31-6/01, 6/28-6/29			1240
Species Captured	Male	Female	Unknown	Total # of Animals Trapped	Total # Animals/1000 Trap Nights
<i>Sorex Spp</i>	.	2	6	8	6.5
<i>Blarina brevicauda</i>	.	.	.	0	0.0
<i>Neotamias minimus</i>	.	.	.	0	0.0
<i>Spermophilus tridecemlineatus</i>	.	.	.	0	0.0
<i>Reithrodontomys megalotis</i>	.	.	.	0	0.0
<i>Peromyscus leucopus</i>	.	.	.	0	0.0
<i>Peromyscus maniculatus</i>	3	3	.	6	4.8
<i>Clethrionomys gapperi</i>	9	3	.	12	9.7
<i>Microtus longicaudus</i>	.	2	.	2	1.6
<i>Microtus ochrogaster</i>	.	.	.	0	0.0
<i>Microtus pennsylvanicus</i>	13	7	.	20	16.1
<i>Zapus hudsonius</i>	7	3	.	10	8.1

Appendix F. Photographs of *Zapus hudsonius* from which ear tissue punches were taken. ZAHU ### corresponds to tissue sampling numbers. Photos with numbers missing from sequence were either not taken because those mice were collected as voucher specimens or due to camera operator



ZAHU 001



ZAHU 002



ZAHU 004



ZAHU 005



ZAHU 006



ZAHU 007



ZAHU 008



ZAHU 009



ZAHU 010



ZAHU 012



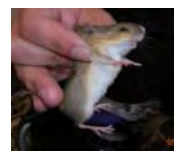
ZAHU 013



ZAHU 014



ZAHU 015



ZAHU 016



ZAHU 017



ZAHU 018



ZAHU 019



ZAHU 020



ZAHU 021



ZAHU 022



ZAHU 023



ZAHU 024



ZAHU 025



ZAHU 026



ZAHU 027



ZAHU 028



ZAHU 029



ZAHU 030



ZAHU 031



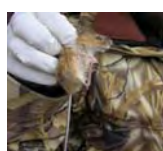
ZAHU 032



ZAHU 033



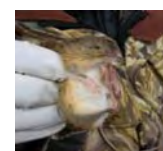
ZAHU 036



ZAHU 037



ZAHU 038



ZAHU 039

Appendix F. Photos of *Zapus hudsonius* (continued)



ZAHU 040



ZAHU 041



ZAHU 042



ZAHU 043



ZAHU 044



ZAHU 045



ZAHU 046



ZAHU 047



ZAHU 048



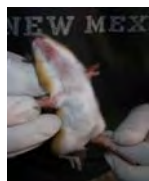
ZAHU 049



ZAHU 050



ZAHU 051



ZAHU 052



ZAHU 053



ZAHU 054



ZAHU 055



ZAHU 056



ZAHU 057



ZAHU 058



ZAHU 059



ZAHU 060



ZAHU 061



ZAHU 062



ZAHU 063



ZAHU 064



ZAHU 067



ZAHU 068



ZAHU 069



ZAHU 070



ZAHU 071



ZAHU 072



ZAHU 073



ZAHU 074



ZAHU 075



ZAHU 076





Appendix F. Photos of *Zapus hudsonius* (continued)



ZAHU 109



ZAHU 110



ZAHU 112



ZAHU 113



ZAHU 114



ZAHU 115



ZAHU 116



ZAHU 117



ZAHU 118



ZAHU 119



ZAHU 120



ZAHU 123



ZAHU 124



ZAHU 125



ZAHU 126



ZAHU 127



ZAHU 128



ZAHU 129



ZAHU 131



ZAHU 132



ZAHU 133



ZAHU 134



ZAHU 135



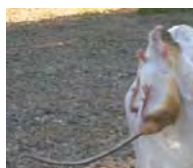
ZAHU 136



ZAHU 137



ZAHU 138



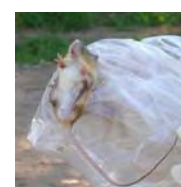
ZAHU 139



ZAHU 140



ZAHU 141



ZAHU 142



ZAHU 143